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(54) **CENTRIFUGAL FAN HAVING A FLOW CONTROL MEMBER**

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F04D 29/66 (2006.01)
F04D 29/40 (2006.01)
F04D 25/06 (2006.01)
F04D 29/42 (2006.01)

(52) **U.S. Cl.**

CPC ***F04D 17/16*** (2013.01); ***F04D 25/0613*** (2013.01); ***F04D 29/4226*** (2013.01); ***F04D 29/667*** (2013.01)

(58) **Field of Classification Search**

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USPC 415/203–206

See application file for complete search history.

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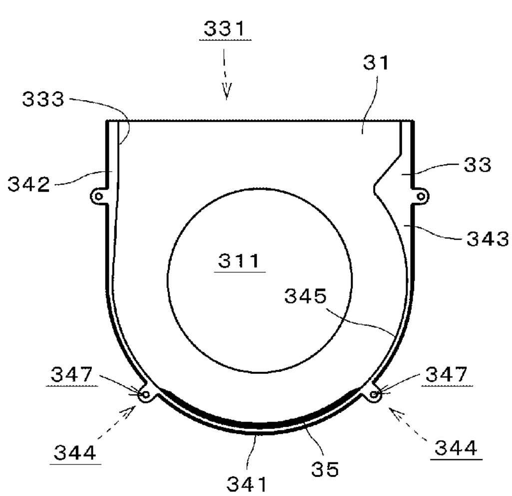
(57) **ABSTRACT**

A centrifugal fan includes an impeller, a motor portion, and a housing. The housing includes an upper plate portion, a lower plate portion arranged to have the motor portion fixed thereto; and a side wall portion. A flow control member is arranged to extend in a line along a boundary between an inside surface of the side wall portion and one of a lower surface of the upper plate portion and an upper surface of the lower plate portion. The flow control member includes a flow control surface arranged to extend radially outward from the one of the lower surface of the upper plate portion and the upper surface of the lower plate portion to the inside surface of the side wall portion while becoming more distant from the one of the lower surface of the upper plate portion and the upper surface of the lower plate portion.

10 Claims, 5 Drawing Sheets



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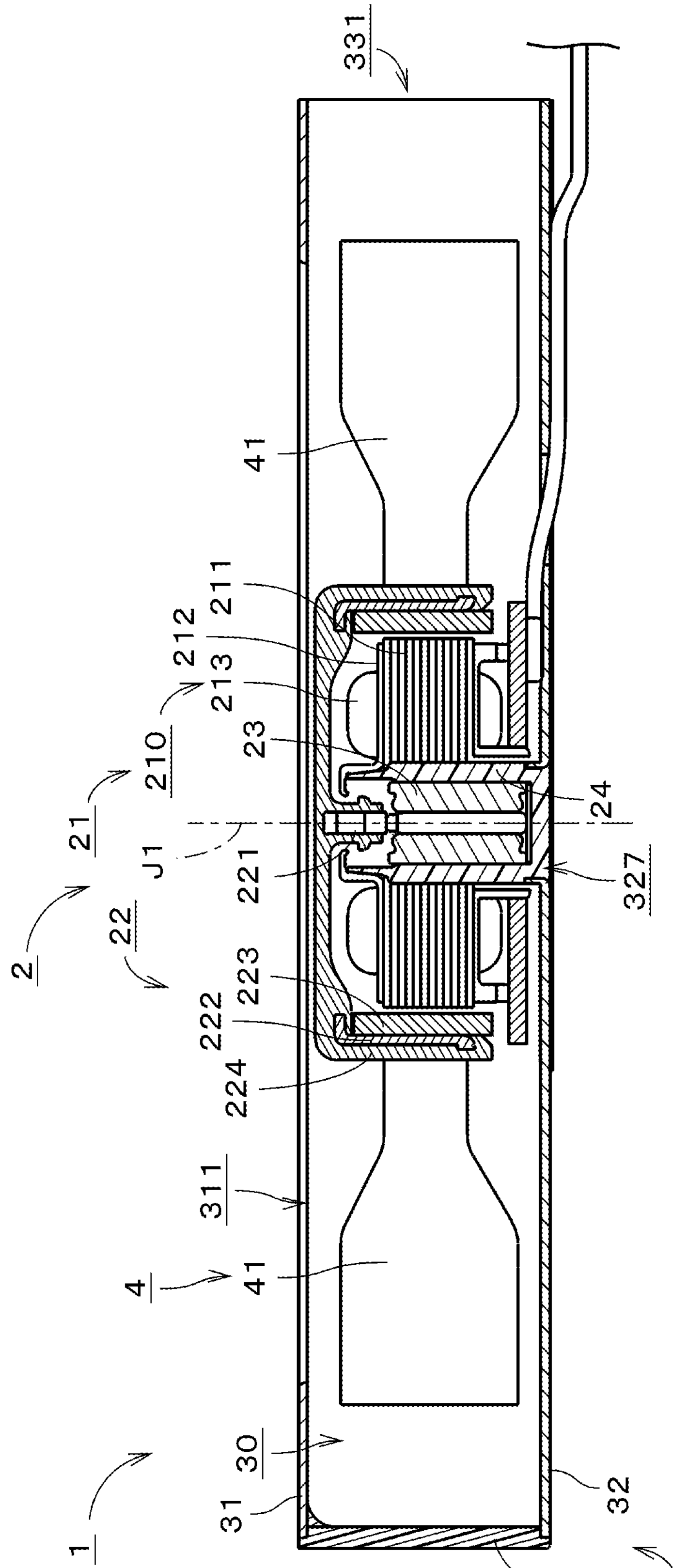

331
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J1
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Fig. 1

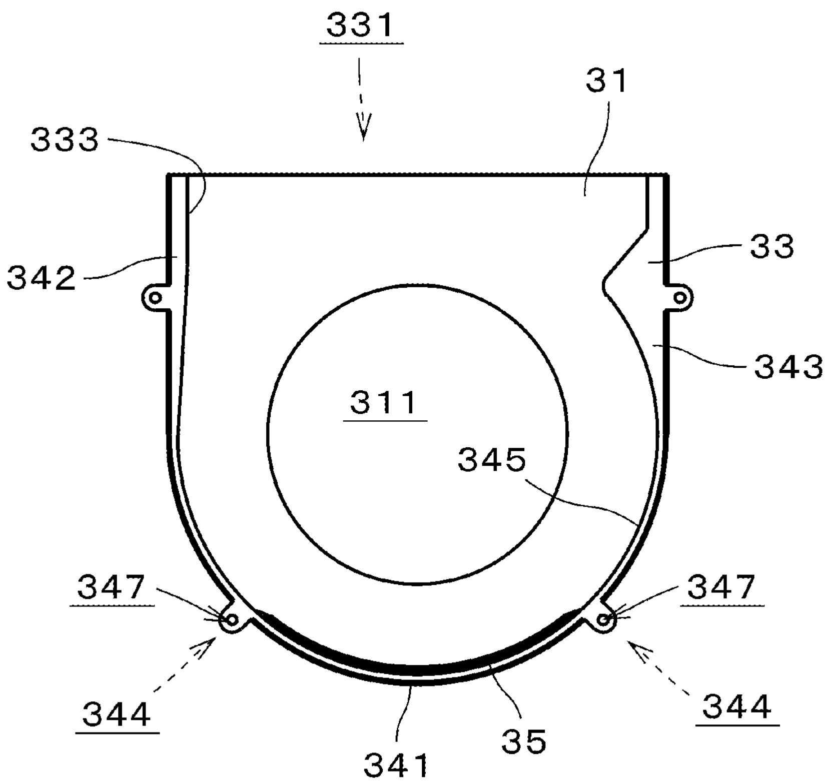

Fig. 2

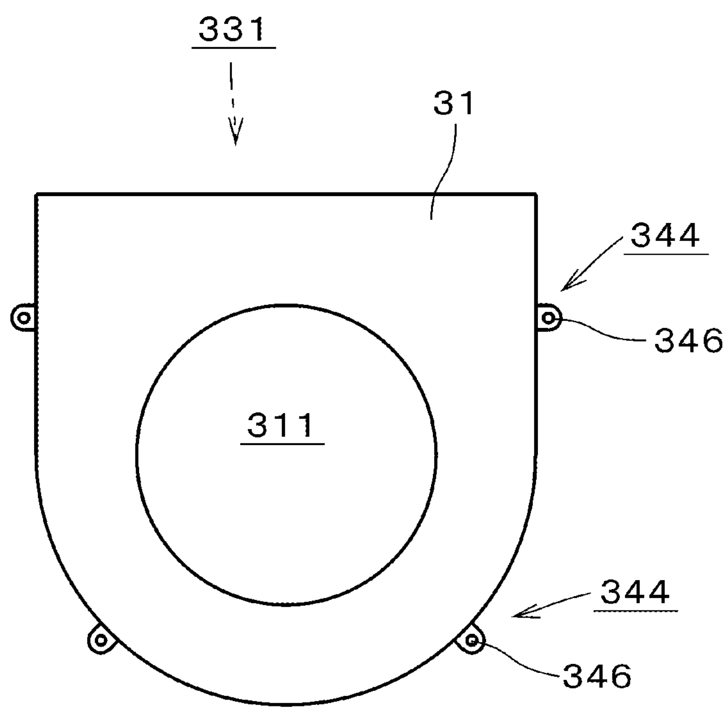

Fig. 3

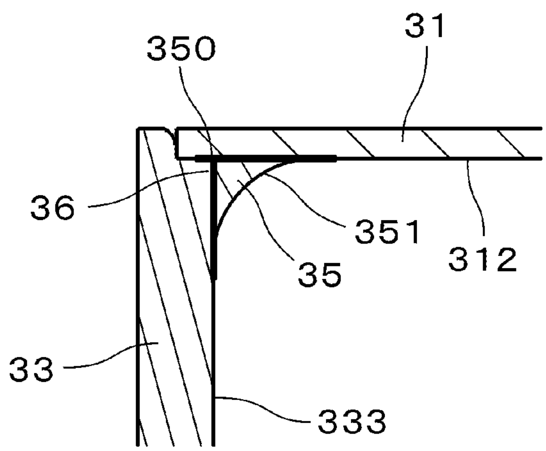

Fig. 4

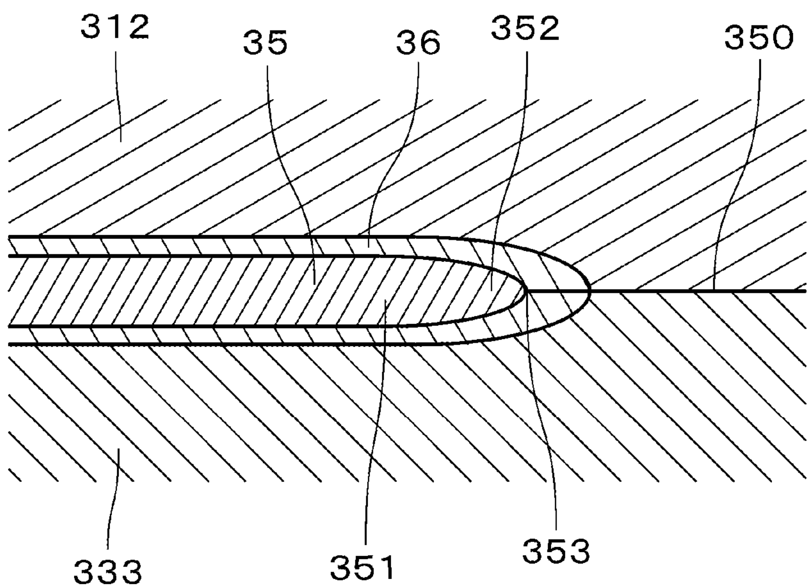

Fig. 5

CENTRIFUGAL FAN HAVING A FLOW CONTROL MEMBER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a centrifugal fan.

2. Description of the Related Art

Small and high-performance electronic devices, such as notebook PCs, produce a large amount of heat at CPUs and the like inside chassis thereof. This makes it important to take measures against the heat. One common measure against the heat is to install blower fans inside the chassis to discharge the heat. Meanwhile, there has been a demand for a reduction in thickness of the notebook PCs. Accordingly, the blower fans have been required to be reduced in thickness while reducing a deterioration in air-blowing performance.

In the case where a centrifugal fan is used as such a blower fan, members each of which is made of a metal or a resin and is in the shape of a thin plate are combined together to define a housing in order to fulfill the above requirement. A fan casing described in JP-A 2008-157216, for example, is made up of a frame and a cover. The frame includes a bottom portion and a side wall portion, and is molded by die casting using a resin or an aluminum alloy. The cover is made of a resin or a metal, and is defined in the shape of a plate. The cover is fixed on the frame.

In the case where the plate in the shape of a board is attached to the side wall portion, a right-angled corner portion is defined between the side wall portion and the plate inside the housing. An air sent radially outward from an impeller stays in the corner portion. This results in a decrease in efficiency with which an air is sent out through an air outlet. Moreover, since an air current is disturbed at the corner portion, the corner portion becomes a cause for noise as well.

SUMMARY OF THE INVENTION

A centrifugal fan according to a preferred embodiment of the present invention includes an impeller centered on a central axis extending in a vertical direction; a motor portion arranged to rotate the impeller about the central axis; and a housing arranged to accommodate the impeller. The housing includes an upper plate portion arranged to cover an upper side of the impeller; a lower plate portion arranged to cover a lower side of the impeller, and arranged to have the motor portion fixed thereto; and a side wall portion arranged to cover a side of the impeller, and arranged to define an air outlet together with the upper and lower plate portions. At least one of the upper and lower plate portions includes an air inlet. The upper plate portion, the side wall portion, and the lower plate portion are arranged to together define an air channel portion arranged to surround the impeller. A boundary between an inside surface of the side wall portion and one of a lower surface of the upper plate portion and an upper surface of the lower plate portion is arranged to have a flow control member arranged thereon, the flow control member extending in a line along the boundary. The flow control member includes a flow control surface arranged to extend radially outward from the one of the lower surface of the upper plate portion and the upper surface of the lower plate portion to the inside surface of the side wall portion while becoming more distant from the one of the lower surface of the upper plate portion and the upper surface of the lower plate portion.

The centrifugal fan according to the above preferred embodiment of the present invention is able to achieve an improvement in air blowing efficiency.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a cross-sectional view of a centrifugal fan according to a preferred embodiment of the present invention.

FIG. **2** is a bottom view of an assembly made up of an upper plate portion and a side wall portion according to the preferred embodiment.

FIG. **3** is a plan view of the assembly made up of the upper plate portion and the side wall portion.

FIG. **4** is a vertical cross-sectional view of the upper plate portion, the side wall portion, and a flow control member according to the preferred embodiment.

FIG. **5** is a diagram illustrating a circumferential end portion of the flow control member and its vicinity as viewed from obliquely downward according to the preferred embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

It is assumed herein that an upper side and a lower side in a direction parallel to a central axis a centrifugal fan illustrated in FIG. **1** are referred to simply as an upper side and a lower side, respectively. Note that a vertical direction assumed herein may not necessarily correspond with a vertical direction of the centrifugal fan when the centrifugal fan is actually installed in a device. It is also assumed herein that a circumferential direction about the central axis is simply referred to by the term "circumferential direction", "circumferential", or "circumferentially", that radial directions centered on the central axis are simply referred to by the term "radial direction", "radial", or "radially", and that the direction parallel to the central axis is simply referred to by the term "axial direction", "axial", or "axially".

FIG. **1** is a cross-sectional view of a centrifugal fan **1** according to a preferred embodiment of the present invention. The centrifugal fan **1** is, for example, installed in a notebook personal computer (hereinafter referred to as a "notebook PC"), and is used to cool devices inside a chassis of the notebook PC.

The centrifugal fan **1** includes a motor portion **2**, a housing **3**, and an impeller **4**. The impeller **4** is centered on a central axis J1 extending in the vertical direction. The motor portion **2** is arranged to rotate the impeller **4** about the central axis J1. The housing **3** is arranged to accommodate the motor portion **2** and the impeller **4**.

The housing **3** includes an upper plate portion **31**, a lower plate portion **32**, and a side wall portion **33**. The upper plate portion **31** is arranged to cover an upper side of the impeller **4**. The lower plate portion **32** is arranged to cover a lower side of the impeller **4**. The motor portion **2** is fixed to the lower plate portion **32**. The side wall portion **33** is arranged to cover a side of the impeller **4**. The side wall portion **33** is arranged to define an air outlet **331** together with the upper and lower plate portions **31** and **32**. The upper plate portion **31**, the side wall portion **33**, and the lower plate portion **32** are arranged to together define an air channel portion **30** arranged to surround the impeller **4**.

Each of the upper and lower plate portions **31** and **32** is made of a metal, such as an aluminum alloy or stainless steel, and is defined in the shape of a thin plate. The side wall portion **33** is made of an aluminum alloy, and is molded by die casting. A lower end portion of the side wall portion **33** and an edge portion of the lower plate portion **32** are screwed and fastened to each other. The upper plate portion **31** is fixed to an upper end portion of the side wall portion **33** by crimping. The upper plate portion **31** includes an air inlet **311**. The air inlet **311** is arranged above the impeller **4**.

The motor portion **2** is of an outer-rotor type. The motor portion **2** includes a stationary portion **21**, which is a stationary assembly, a rotating portion **22**, which is a rotating assembly, and a sleeve **23**, which is a bearing. The sleeve **23** is substantially cylindrical and centered on the central axis J1. The rotating portion **22** is supported by the sleeve **23** such that the rotating portion **22** is rotatable about the central axis J1 with respect to the stationary portion **21**.

The stationary portion **21** includes a stator **210** and a bearing support portion **24**. The bearing support portion **24** is arranged to accommodate the sleeve **23**. The bearing support portion **24** is substantially cylindrical and centered on the central axis J1, and is made of a resin. The bearing support portion **24** is arranged to project upward from a substantial center of the lower plate portion **32**. The bearing support portion **24** is fixed in a hole portion **327** defined in the lower plate portion **32**. A lower end portion of the bearing support portion **24** and a portion of the lower plate portion **32** around the hole portion **327** are joined to each other by an insert molding process.

The stator **210** is an annular member centered on the central axis J1. The stator **210** is attached to an outside surface of the bearing support portion **24**. The stator **210** includes a stator core **211**, an insulator **212**, and coils **213**. The stator core **211** is defined by laminated silicon steel sheets, each of which is in the shape of a thin plate. The insulator **212** is made of an insulating material, and is arranged to cover a surface of the stator core **211**.

The rotating portion **22** includes a shaft **221**, a yoke **222**, a rotor magnet **223**, and a cup **224**. The cup **224** has a bottom and is substantially cylindrical, and is centered on the central axis J1. The cup **224** is arranged to be open downwardly. The shaft **221** is centered on the central axis J1, and an upper end portion of the shaft **221** is fixed to the cup **224**. The yoke **222** is substantially cylindrical and centered on the central axis J1, and is fixed to an inside surface of the cup **224**. The rotor magnet **223** is substantially cylindrical and centered on the central axis J1, and is fixed to an inside surface of the yoke **222**.

The shaft **221** is inserted in the sleeve **23**. The sleeve **23** is defined by an oil-bearing porous metal body, and is inserted and fixed in the bearing support portion **24**. Note that a ball bearing, for example, may be used as a bearing mechanism.

The impeller **4** includes a plurality of blades **41**. The blades **41** are arranged on an outside of the cup **224** in an annular shape centered on the central axis J1. A radially inner end portion of each blade **41** is fixed to an outside surface of the cup **224**. A torque centered on the central axis J1 is produced between the rotor magnet **223** and the stator **210** as a result of supply of a current to the stationary portion **21**. The impeller **4** is thereby caused to rotate about the central axis J1 together with the rotating portion **22**. Rotation of the impeller **4** causes an air to be drawn into the housing **3** through the air inlet **311**, and to be sent out through the air outlet **331**.

FIG. **2** is a bottom view of an assembly made up of the upper plate portion **31** and the side wall portion **33**. FIG. **3** is a plan view of the assembly. The air outlet **331** is arranged on an upper side in each of FIGS. **2** and **3**. The side wall portion **33** includes a first side wall portion **341**, a second side wall portion **342**, and a third side wall portion **343**. The first side wall portion **341** is arranged on an opposite side of the air inlet **311** with respect to the air outlet **331**. That is, the first side wall portion **341** is arranged on an opposite side of the impeller **4** with respect to the air outlet **331**.

The first side wall portion **341** is arranged to extend in a curve along an outer circumference of the impeller **4**. The first side wall portion **341** is arranged to extend in a circumferential direction about an axis displaced from the central axis J1. An inside surface of the first side wall portion **341** is also arranged to extend in a curve along the outer circumference of the impeller **4**. That is, an inside surface **333** of the side wall portion **33** includes a curved surface **345** arranged to extend in a curve along the outer circumference of the impeller **4** on the opposite side of the impeller **4** with respect to the air outlet **331**.

The second side wall portion **342** is arranged to extend from the first side wall portion **341** in a rotation direction of the impeller **4**. The third side wall portion **343** is arranged to extend from the first side wall portion **341** in a direction opposite to the rotation direction of the impeller **4**. The first side wall portion **341** is arranged to have a radial thickness smaller than the thickness of each of the second and third side wall portions **342** and **343** measured in a lateral direction in FIG. **2**.

Referring to FIG. **3**, the side wall portion **33** and the upper plate portion **31** are united with each other through a plurality of crimping portions **344**. A portion of each crimping portion **344** which is included in the side wall portion **33** includes a projection **346** arranged to slightly project upward. A portion of the crimping portion **344** which is included in the upper plate portion **31** includes a hole portion into which the projection **346** is inserted. The projection **346** of each crimping portion **344** is inserted into the hole portion of the crimping portion **344**, and the projection **346** is thereafter slightly crushed, so that the side wall portion **33** and the upper plate portion **31** are united with each other. A portion of the upper plate portion **31** around each hole portion is arranged at a level slightly lower than that of a remaining portion of the upper plate portion **31**.

In the present preferred embodiment, each projection **346** is arranged on a portion of the side wall portion **33** which is arranged to project outward in a horizontal direction. Note, however, that the position of each projection **346** may be modified appropriately. In the present preferred embodiment, two of the crimping portions **344** are arranged in the first side wall portion **341**, one of the crimping portions **344** is arranged in the second side wall portion **342**, and one of the crimping portions **344** is arranged in the third side wall portion **343**.

Referring to FIG. **2**, a plurality of screw holes **347** are defined in portions of the side wall portion **33** under the projections **346**. Each of the screw holes **347** is used to fasten the lower plate portion **32** and the side wall portion **33** to each other. Each screw hole **347** is arranged to be recessed upward from a lower surface of the side wall portion **33**.

Referring to FIG. **2**, a flow control member **35** is arranged at a boundary between a lower surface of the upper plate portion **31** and the inside surface **333** of the side wall portion **33**. The flow control member **35** is arranged to extend in a line along the boundary. In the present preferred embodiment, the flow control member **35** is arranged at a boundary between the lower surface of the upper plate portion **31** and the inside surface of the first side wall portion **341**. In more detail, the flow control member **35** is arranged between the two crimping portions **344** that are most distant from the air outlet **331**, that is, between the two crimping portions **344** arranged in the first side wall portion **341**.

FIG. **4** is a vertical cross-sectional view of the upper plate portion **31**, the side wall portion **33**, and the flow control member **35**. The flow control member **35** includes a flow control surface **351** arranged to face the impeller **4**. The flow control surface **351** is arranged to extend from a lower surface **312** of the upper plate portion **31** to the inside surface **333** of the side wall portion **33**. The flow control surface **351** is arranged to extend radially outward and axially downward from the lower surface **312** while becoming more distant from the lower surface **312**. The flow control member **35** is defined by applying an adhesive along a boundary **350** between the lower surface **312** and the inside surface **333**. The adhesive used to define the flow control member **35** is made of a material that substantially functions as an adhesive, and may be made of a material that is not used as an adhesive. The flow control member **35** is preferably defined by a cured resin which has originally been fluid. This makes it easier to make the flow control member **35** have an ideal shape.

Provision of the flow control member **35** prevents a corner portion between the lower surface **312** of the upper plate portion **31** and the inside surface **333** of the side wall portion **33** from forming a right angle, and causes the lower surface **312** and the inside surface **333** to be joined to each other smoothly. This contributes to reducing a disturbance in an air which has been sucked in through the air inlet **311** by the impeller **4** and is now traveling radially outward, and smoothening a circumferential flow of the air. This results in an improved air blowing efficiency of the centrifugal fan **1**. Moreover, the flow control surface **351** is arranged to be concave, being recessed toward the boundary **350**, and this leads to an additional improvement in the air blowing efficiency of the centrifugal fan **1**.

The flow control member **35** is bonded to both the lower surface **312** of the upper plate portion **31** and the inside surface **333** of the side wall portion **33**. Here, the flow control member **35** being "bonded" to both the lower surface **312** and the inside surface **333** means that the flow control member **35** is so firmly adhered to both the lower surface **312** and the inside surface **333** that the flow control member **35** is not easily detached from the lower surface **312** or the inside surface **333**. This bonding contributes to reducing vibrations of the upper plate portion **31** and the side wall portion **33**. In particular, vibrations tend to occur with a high probability at an area between the two crimping portions **344** that are most distant from the air outlet **331**, and provision of the flow control member **35** in this area leads to an effective reduction in the vibrations of the upper plate portion **31** and the side wall portion **33**. Moreover, since crimping is additionally used to unite the upper plate portion **31** and the side wall portion **33** with each other, the upper plate portion **31** and the side wall portion **33** are firmly united with each other.

Note that the two crimping portions **344** that are most distant from the air outlet **331** refer to the most distant crimping portion **344** and the second most distant crimping portion **344**. In other words, the two crimping portions **344** that are most distant from the air outlet **331** refer to a pair of adjacent ones of the crimping portions **344** in the side wall portion **33** that is most distant from the air outlet **331**. Also note that, in the case where the air outlet **331** is a straight line in a plan view, the distance between the air outlet **331** and each crimping portion **344** refers to the distance between the straight line and the crimping portion **344**, whereas in the case where the air outlet **331** is a curve in the plan view, the distance between the air outlet **331** and each crimping portion **344** refers to the distance between a straight line which is an approximation obtained by a least squares method or the like and the crimping portion **344**.

According to the present preferred embodiment, because the first side wall portion **341** is thinner than each of the second and third side wall portions **342** and **343**, the first side wall portion **341** tends to easily become a cause for vibrations. Even with this structure, provision of the flow control member **35** at a boundary between the upper plate portion **31** and the first side wall portion **341** reduces the vibrations effectively.

An oil-repellent agent is applied along the boundary **350** to define an oil-repellent film **36**. A portion of the oil-repellent agent enters into a gap between the upper plate portion **31** and the side wall portion **33**. In FIG. **4**, the oil-repellent film **36** existing on the boundary **350** is represented by a thick line. At the time of application of the adhesive, the oil-repellent film **36** serves to prevent the adhesive from leaking out of the housing **3**. The flow control member **35** is bonded to the lower surface **312** of the upper plate portion **31** radially outside a radially inner edge of the oil-repellent film **36**. The flow control member **35** is bonded to the inside surface **333** of the side wall portion **33** axially above an axially lower edge of the oil-repellent film **36**. That is, the oil-repellent film **36** is arranged to intervene between the entire flow control member **35** and each of the lower surface **312** and the inside surface **333**. The upper plate portion **31** and the side wall portion **33** are united with each other through the flow control member **35** with the above intervention of the oil-repellent film **36**.

FIG. **5** is a diagram illustrating a circumferential end portion **352** of the flow control member **35** and its vicinity as viewed from a direction of the impeller **4**, that is, from obliquely downward. In FIG. **5**, each member is hatched with parallel oblique lines. The oil-repellent film **36** is arranged to extend along the boundary **350** circumferentially outward beyond the end portion **352** of the flow control member **35**, and is also arranged to extend along the boundary **350** circumferentially outward beyond an opposite end portion **352** of the flow control member **35**. This contributes to preventing the adhesive from leaking out of the housing **3** through an end portion of the oil-repellent film **36** at the time of the application of the adhesive.

The width of the flow control member **35** is arranged to gradually decrease toward an end point **353** at each end portion **352**. The width of the flow control member **35** refers to the width of the flow control surface **351** in a section taken along a plane perpendicular to the boundary **350**. The flow control surface **351** is accordingly arranged to approach the boundary **350** with decreasing distance from the end point **353**. The flow control member **35** having such a shape contributes to reducing a disturbance in an air current at the end portion **352**, and thereby preventing a decrease in the air blowing efficiency.

While preferred embodiments of the present invention have been described above, it is to be understood that the present invention is not limited to the above-described preferred embodiments, and that a variety of modifications are possible.

Although the flow control member **35** is arranged between the two crimping portions **344** in the first side wall portion **341** according to the above-described preferred embodiment, the arrangement of the flow control member **35** may be modified appropriately. For example, the flow control member **35** may be arranged to extend over the entire first side wall portion **341**, or may be arranged to extend from the first side wall portion **341** into the second side wall portion **342** or the third side wall portion **343**. That is, at least a portion of the flow control member **35** is arranged to extend along a boundary between the lower surface **312** of the upper plate portion **31** and the curved surface **345** of the side wall portion **33** illustrated in FIG. **2**. This leads to an effective improvement in the air blowing efficiency.

Note that the air inlet may be defined in the lower plate portion **32**. That is, the air inlet is defined in the upper plate portion **31** or the lower plate portion **32**. The wording "the upper plate portion **31** or the lower plate portion **32**" here means "at least one of the upper plate portion **31** and the lower plate portion **32**". Since provision of the air inlet reduces rigidity of the plate portion in which the air inlet is defined, it is preferable that the flow control member **35** should be arranged at the boundary between the inside surface **333** of the side wall portion **33** and the lower surface **312** of the upper plate portion **31** in the case where the air inlet is defined in the upper plate portion **31**, and at a boundary between the inside surface **333** of the side wall portion **33** and an upper surface of the lower plate portion **32** in the case where the air inlet is defined in the lower plate portion **32**. This contributes to reducing the vibrations. Note that the flow control member **35** may be arranged at a boundary between the side wall portion **33** and the plate portion in which the air inlet is not defined.

A structure in which the flow control member **35**, made of the adhesive, is arranged at the boundary between the upper surface of the lower plate portion **32** and the inside surface **333** of the side wall portion **33** is also suitable for a reduction in the vibrations in the case where the lower plate portion **32** and the side wall portion **33** are united with each other by crimping.

Note that the flow control member **35** may be arranged at each of the boundary between the lower surface **312** of the upper plate portion **31** and the inside surface **333** of the side wall portion **33** and the boundary between the upper surface of the lower plate portion **32** and the inside surface **333** of the side wall portion **33**. Also note that the flow control member **35** may be a member separately molded of a material other than the adhesive, e.g., a resin. In this case, the flow control member **35** is arranged on the boundary **350** through an adhesive or the like.

Note that the flow control surface **351** may not necessarily assume a concave shape in a vertical section taken along a plane including the central axis J**1**. For example, the flow control surface **351** may assume a straight line in the vertical section.

Also note that the oil-repellent film **36** may be omitted if the oil-repellent film **36** is not necessary to prevent the adhesive from leaking out of the housing **3**. Also note that the oil-repellent film **36** may be replaced with another material.

Centrifugal fans according to preferred embodiments of the present invention are usable to cool devices inside chassis, for example, of notebook PCs and desktop PCs, to cool other devices, to supply an air to a variety of objects, and so on. Moreover, centrifugal fans according to preferred embodiments of the present invention are also usable for other purposes.

Features of the above-described preferred embodiments and the modifications thereof may be combined appropriately as long as no conflict arises.

While preferred embodiments of the present invention have been described above, it is to be understood that variations and modifications will be apparent to those skilled in the art without departing from the scope and spirit of the present invention. The scope of the present invention, therefore, is to be determined solely by the following claims.

What is claimed is:

1. A centrifugal fan comprising:

an impeller centered on a central axis extending in a vertical direction;

a motor portion arranged to rotate the impeller about the central axis; and

a housing arranged to accommodate the impeller; wherein the housing includes:

an upper plate portion arranged to cover an upper side of the impeller;

a lower plate portion arranged to cover a lower side of the impeller, and arranged to have the motor portion fixed thereto; and

a side wall portion arranged to cover a side of the impeller, and arranged to define an air outlet together with the upper and lower plate portions;

at least one of the upper and lower plate portions includes an air inlet;

the upper plate portion, the side wall portion, and the lower plate portion are arranged to together define an air channel portion arranged to surround the impeller;

a boundary between an inside surface of the side wall portion and one of a lower surface of the upper plate portion and an upper surface of the lower plate portion is arranged to have a member arranged thereon, the member extending in a line along the boundary; and

the member includes a flow control surface arranged to extend radially outward from the one of the lower surface of the upper plate portion and the upper surface of the lower plate portion to the inside surface of the side wall portion while becoming more distant from the one of the lower surface of the upper plate portion and the upper surface of the lower plate portion

wherein

the side wall portion includes:

a first side wall portion arranged to extend in a curve along an outer circumference of the impeller on an opposite side of the impeller with respect to the air outlet;

a second side wall portion arranged to extend from the first side wall portion in a rotation direction of the impeller; and

a third side wall portion arranged to extend from the first side wall portion in a direction opposite to the rotation direction of the impeller;

the member is arranged on a boundary between an inside surface of the first side wall portion and the one of the lower surface of the upper plate portion and the upper surface of the lower plate portion; and

the first side wall portion is arranged to have a thickness smaller than that of each of the second and third side wall portions.

2. The centrifugal fan according to claim **1**, wherein

the inside surface of the side wall portion includes a curved surface arranged to extend in a curve along an outer circumference of the impeller on an opposite side of the impeller with respect to the air outlet.

3. The centrifugal fan according to claim **1**, wherein, at both end portions of the member in a circumferential direction about the central axis, the flow control surface is arranged to approach the boundary while gradually decreasing in width with decreasing distance from circumferential end points of the member.

4. The centrifugal fan according to claim **1**, wherein the flow control surface is arranged to be concave, being recessed toward the boundary.

5. The centrifugal fan according to claim **1**, wherein the member is bonded to both the inside surface of the side wall portion and the one of the lower surface of the upper plate portion and the upper surface of the lower plate portion.

6. The centrifugal fan according to claim **1**, wherein the member is defined by a cured resin which has originally been fluid.

7. The centrifugal fan according to claim **1**, further comprising an oil-repellent film arranged on the boundary, wherein the oil-repellent film is arranged to extend circumferentially outward beyond each of both end portions of the member in a circumferential direction about the central axis.

8. The centrifugal fan according to claim **7**, wherein the oil-repellent film is arranged to intervene between the entire member and each of the inside surface of the side wall portion and the one of the lower surface of the upper plate portion and the upper surface of the lower plate portion.

9. The centrifugal fan according to claim **1**, wherein

the side wall portion and one of the upper and lower plate portions which includes the one of the lower surface of the upper plate portion and the upper surface of the lower plate portion are united with each other through a plurality of crimping portions; and

the member is arranged between two of the crimping portions that are most distant from the air outlet.

10. The centrifugal fan according to claim **1**, wherein the air inlet is defined in the upper plate portion, and the one of the lower surface of the upper plate portion and the upper surface of the lower plate portion is the lower surface of the upper plate portion.

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